AMENDMENTS

IN THE CLAIMS

Please amend the claims as follows.

What is claimed is:

1. A method for forming a top [metalization] metallization system for high performance integrated circuits, comprising:

forming an integrated circuit [comprising] containing a plurality of devices formed in and on a semiconductor substrate, with an overlaying interconnecting [metalization] metallization structure connected to said devices and [comprising] containing a plurality of first metal lines in one or more layers;

depositing a passivation layer over said interconnecting [metalization] metallization structure;

depositing an insulating, separating layer over said passivation layer that is substantially thicker than said passivation layer;

forming openings through said insulating, separating layer and said passivation layer to expose upper metal portions of said overlaying interconnecting [metalization] metallization structure;

depositing metal contacts in said openings; and

forming said top [metalization] metallization system connected to said overlaying interconnecting [metalization] metallization

structure, wherein said top [metalization] metallization system [comprises] contains a plurality of top metal lines, in one or more layers, each of said top metal lines having a width substantially greater than said first metal lines.

2. The method of claim 1 wherein [the] said top [metalization] metallization system connects portions of said interconnecting [metalization] metallization structure to other portions of said interconnecting [metalization] metallization structure.

3. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains signal lines that are substantially wider than lines in said interconnecting [metalization] metallization structure.

4. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains power planes having power buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

5. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains ground planes having ground buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

6. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains planes that contain both signal lines and power buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

7. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains planes that contain both signal lines and ground buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

8. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains planes that contain both power buses and ground buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

9. The method of claim 1 wherein said overlaying interconnecting [metalization] metallization structure [comprises] contains electrical contact points.

10. The method of claim 9 wherein [the] a size of said contact points is within the range of approximately 0.3 um. to 5.0 um.

11. The method of claim 1 wherein said passivation layer [comprises] contains Plasma Enhanced CVD (PECVD) oxide.

12. The method of claim 1 wherein said passivation layer [comprises] contains Plasma Enhanced CVD (PECVD) nitride.

13. The method of claim 1 wherein said passivation layer [comprises] contains a layer with a thickness within [the] a range of approximately 0.15 to 2.0 um of Plasma Enhanced CVD (PECVD) oxide over which a layer with a thickness within [the] a range of approximately 0.5 to 2.0 um PECVD nitride is deposited.

14. The method of claim 1 wherein said insulating, separating layer is a polymer dielectric layer [or any other appropriate insulating material].

15. The method of claim 1 wherein said insulating, separating layers [comprises] contains polyimide.

16. The method of claim 1 wherein said insulating, separating layers [comprises] contains polymer benzocyclobutene (BCB).

17. The method of claim 1 wherein said insulating, separating layers is of a thickness after curing within [the] a range of approximately 1.0 to 30 um.

19. The method of claim 1 wherein said insulating, separating layers after said spin-on coating are cured at a temperature within [the] a range of approximately 250 to 450 degrees C. for a time within [the] a range of approximately 0.5 to 1.5 hours said curing to occur within a vacuum or nitrogen ambient.

21. The method of claim 20 wherein one or more of said one or more insulating, separating layers after each process step of said spin on coating are cured at a temperature within [the] a range of approximately 250 to 450 degrees C. for a time within [the] a range of approximately 0.5 to 1.5 hours said curing [the] to occur within a vacuum or nitrogen ambient.

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22. The method of claim 1 wherein said openings have an aspect ratio within [the] a range of approximately 1 to 10.

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23. The method of claim 1 wherein said metal contacts are selected from a group [comprise] containing sputtered aluminum,

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CVD tungsten, CVD copper, electroplated copper and electroless nickel.

17 ~~25~~. The method of claim 1 wherein said top [metalization] metallization system [comprises] contains contact pads on [the] a top metal layer whereby said contact pad can contain [comprise any appropriate contact material, such as but not limited to] tungsten, chromium, copper (electroplated or electroless), aluminum[,] or polysilicon [, or the like].

18 ~~26~~. The method of claim 1 wherein said top metal layer [comprises] contains contact pads, said contact pads [comprising] containing signal connection pads whereby said signal connection pads can contain [comprise any appropriate contact material, such as but not limited to] tungsten, chromium, copper (electroplated or electroless), aluminum[,] or polysilicon [, or the like].

19 ~~27~~. The method of claim 1 wherein said top [metalization] metallization system contains contact pads on [the] a top metal layer, said contact pads containing signal connection pads in addition to power and ground connection pads whereby said signal connection pads can contain [comprise any appropriate contact material, such as but not limited to] tungsten, chromium, copper

(electroplated or electroless), aluminum[,] or polysilicon [, or the like].

20/28. The method of claim 19/27 wherein said signal pads are mounted in [the] a periphery of said top [metalization] metallization system and said power and ground connection pads are mounted within [the] an area enclosed by said signal pads whereby said power and ground connection pads and said signal pads can contain [comprise any appropriate contact material, such as but not limited to] tungsten, chromium, copper (electroplated or electroless), aluminum[,] or polysilicon [, or the like].

29. A semiconductor device structure comprising:

a semiconductor substrate [comprising] containing semiconductor devices;

an interconnecting [metalization] metallization structure connected to said devices;

electrical contact points on an upper top surface of said interconnecting [metalization] metallization structure and connected to said interconnecting [metalization] metallization structure;

a passivation layer deposited over said interconnecting [metalization] metallization structure and over said electrical contact points;

an insulating layer deposited over said passivation layer said insulating layer being substantially thicker than said passivation layer;

openings through said insulating layer and through said passivation layer down to [the] an upper surface of said electrical contact points;

metal conductors within said openings; and

an upper [metalization] metallization structure connected to said metal conductors.

30. The [method] structure of claim 29 wherein [the] said upper [metalization] metallization structure connects portions of said interconnecting [metalization] metallization structure to other portions of said interconnecting [metalization] metallization structure.

31. The structure of claim 29 wherein said upper [metalization] metallization structure further comprises:

a plurality of insulating layers;

a plurality of structures of metal interconnecting lines formed between said insulating layers;

a plurality of contact pads in an upper layer of said [metalization] metallization structure; and

a plurality of filled openings connecting said contact pads with one or more of said structures of metal interconnecting lines further connecting said contact pads with said electrical contact points.

32. The structure of claim 31 whereby said metal interconnecting lines are signal lines, and are substantially wider than lines in said interconnecting [metalization] metallization structure.

33. The structure of claim 31 wherein said metal interconnecting lines are power buses, and are substantially wider than lines in said interconnecting [metalization] metallization structure.

34. The structure of claim 31 wherein said metal interconnecting lines are ground buses, and are substantially wider than lines in said interconnecting [metalization] metallization structure.

35. The structure of claim 31 wherein said metal interconnecting lines are a combination of signal lines and power buses, and are substantially wider than lines in said interconnecting [metalization] metallization structure.

36. The structure of claim 31 wherein said metal interconnecting lines are a combination of power and ground buses, and are

substantially wider than lines in said interconnecting [metalization] metallization structure.

37. The structure of claim 31 wherein said metal interconnecting lines are a combination of signal and ground buses, and are substantially wider than lines in said interconnecting [metalization] metallization structure.

38. The structure of claim 29 wherein [the] a size of said contact points is within [the] a range of approximately 0.3 um. to 5.0 um whereby further whereby said contact points can [comprise] contain any appropriate contact material, such as but not limited to tungsten, copper (electroplated or electroless), aluminum, polysilicon, or the like.

39. The structure of claim 29 wherein said passivation layer [comprises] contains a layer within [the] a range of approximately 0.15 to 2.0 um Plasma Enhanced CVD (PECVD) oxide over which a layer within [the] a range of approximately 0.5 to 2.0 um PECVD nitride is deposited.

41. The method of claim 29 wherein said insulating, separating layer [comprises] contains polyimide.

42. The method of claim 29 wherein said insulating, separating layer [comprises] contains the polymer benzocyclobutene (BCB).

43. The structure of claim 29 wherein said insulating layer is of a thickness after curing within [the] a range of approximately 1.0 to 30 um.

44. The structure of claim 29 wherein said openings have an aspect ratio within [the] a range of approximately 1 to 10.

45. The method of claim 29 wherein said metal conductors within said openings through said insulating layer and through said passivation layer connecting said electrical contact pads of said top [metalization] metallization structure with contact points of said interconnecting [metalization] metallization structure are constructed and routed such that each said electrical contact point of said interconnecting [metalization] metallization structure is connected directly and sequentially with one electrical contact point of said top [metalization] metallization structure thereby creating a fan-out effect for said electrical contact point of said interconnecting [metalization] metallization structure whereby [the] a distance between said electrical contact points of said top [metalization] metallization structure is larger than [the] a distance between

said electrical contact points of said interconnecting [metalization] metallization structure by a measurable amount.

46. The method of claim 29 wherein said [the number of said] electrical contact pads of said upper [metalization] metallization structure can exceed in number [be larger than the number of] said contact points of said interconnecting [metalization] metallization structure by a considerable and measurable amount.

47. The method of claim 29 wherein said metal conductors within said openings through said insulating layer and through said passivation layer connecting said electrical contact points of said top [metalization] metallization structure with said contact points of said interconnecting [metalization] metallization structure are constructed and routed such that each said electrical contact point of said interconnecting [metalization] metallization structure is connected directly but not necessarily sequentially with one electrical contact point of said top [metalization] metallization structure thereby creating a pad relocation effect for said electrical contact points of said interconnecting [metalization] metallization structure whereby [the] a distance between said electrical contact points of said top [metalization] metallization structure is larger than [the] a

distance between said electrical contact point of said interconnecting [metalization] metallization structure by a measurable amount whereby furthermore [the] a sequence or adjacency of said electrical contact points of said interconnecting [metalization] metallization structure is not necessarily the same as [the] a sequence or adjacency between said electrical contact points of said top [metalization] metallization structure.

48. The method of claim 29 wherein said metal conductors within said openings through said insulating layer and through said passivation layer connecting said electrical contact points on a top surface of said top [metalization] metallization structure with contact points of said interconnecting [metalization] metallization structure are constructed and routed such that functionally identical electrical contact points of said interconnecting [metalization] metallization structure are interconnected and are connected with one electrical contact point or fewer electrical contact points of said top [metalization] metallization structure thereby creating a reduction effect for said electrical contact points of said interconnecting [metalization] metallization structure whereby [the] a number of contact points for a particular electrical function within said electrical contact points of said top [metalization]

metallization structure is smaller than [the] a number of said electrical contact points of said interconnecting [metalization] metallization structure by a measurable amount whereby furthermore [the] a sequence or adjacency of said electrical contact points of said interconnecting [metalization] metallization structure is not necessarily the same as [the] a sequence or adjacency between said electrical contact points of said top [metalization] metallization structure.

49. A method for forming a top [metalization] metallization system for high performance integrated circuits, comprising:
forming an integrated circuit [comprising] containing a plurality of devices formed in and on a semiconductor substrate, with an overlaying interconnecting [metalization] metallization structure connected to said devices and [comprising] containing a plurality of first metal lines;
depositing an insulating, separating layer over said semiconductor substrate;
forming openings through said insulating, separating layer to expose upper metal portions of said interconnecting [metalization] metallization structure;
depositing metal contacts in said openings; and
forming said top [metalization] metallization system connected to said interconnecting [metalization] metallization structure,

wherein said top [metalization] metallization system [comprises] contains a plurality of top metal lines, in one or more layers, having a width substantially greater than said first metal lines.

50. The method of claim 49 wherein said top [metalization] metallization system [comprises] contains signal lines that are substantially wider than lines in said overlaying interconnecting [metalization] metallization structure.

51. The method of claim 49 wherein said top [metalization] metallization system [comprises] contains power buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

52. The method of claim 49 wherein said top [metalization] metallization system [comprises] contains ground buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

53. The method of claim 49 wherein said top [metalization] metallization system [comprises] contains planes that contain both signal lines and power buses that are substantially wider than lines in said interconnecting [metalization] metallization structure.

54. The method of claim 49 wherein said top [metalization] metallization system [comprises] contains planes that contain both signal lines and ground buses that are substantially wider than lines in said overlaying interconnecting [metalization] metallization structure.

55. The method of claim 49 wherein said top [metalization] metallization system [comprises] contains planes that contain both power buses and ground buses that are substantially wider than lines in said overlaying interconnecting [metalization] metallization structure.

56. The method of claim 49 wherein said overlaying interconnecting [metalization] metallization structure [comprises] contains electrical contact points whereby said contact points can [comprise] contain any appropriate contact material, such as but not limited to tungsten, copper (electroplated or electroless), aluminum, and polysilicon [, or the like].

57. The method of claim 56 wherein [the] a size of said contact points is within the range of approximately 0.3 um. to 5.0 um.

~~58~~ 25. The method of claim ~~49~~ 21 further comprising depositing a passivation layer over said interconnecting [metalization] metallization structure.

~~59~~ 26. The method of claim ~~58~~ 25 wherein said passivation layer [comprises] contains Plasma Enhanced CVD (PECVD) oxide.

~~60~~ 27. The method of claim ~~58~~ 25 wherein said passivation layer [comprises] contains Plasma Enhanced CVD (PECVD) nitride.

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62. The method of claim 49 wherein said insulating, separating layer is selected from the group [comprising] containing polyimide and benzocyclobutene (BCB).

63. A method for forming a top [metalization] metallization system for high performance integrated circuits, comprising:
forming an integrated circuit [comprising] containing a plurality of devices formed in and on a semiconductor substrate, with an overlaying interconnecting [metalization] metallization structure connected to said devices and [comprising] containing a plurality of fine-wire metal lines;
depositing a passivation layer over said interconnecting fine-wire [metalization] metallization structure;

depositing an insulating, separating layer over said passivation layer that is substantially thicker than said passivation layer;

forming openings through said insulating, separating layer to expose upper metal portions of said overlaying interconnecting [metalization] metallization structure;

depositing metal contacts in said openings thereby raising a plurality of contact points in said overlaying interconnecting [metalization] metallization structure to [the] a top surface of said insulating, separating layer thereby creating elevated interconnecting [metalization] metallization contact points;

forming said top [metalization] metallization system connected to said overlaying interconnecting [metalization] metallization structure, wherein said top [metalization] metallization system [comprises] contains a plurality of top wide-metal lines, in one or more layers, having a width substantially greater than said fine-wire metal lines, wherein said top [metalization] metallization system directly interconnects said elevated interconnecting [metalization] metallization contact points thereby functionally extending or connecting said fine-wire metal interconnects with said wide-wire metal interconnects thereby furthermore establishing electrical interconnects between multiple points within said fine-wire interconnects.

30 64. The method of claim 29 63 wherein said top [metalization] metallization system [comprises] contains signal lines that are

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substantially wider than lines in said interconnecting [metalization] metallization structure.

31 29
~~65~~. The method of claim ~~63~~ wherein said top [metalization] metallization system [comprises] contains power planes that are substantially wider than lines in said interconnecting [metalization] metallization structure.

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~~66~~. The method of claim ~~63~~ wherein said top [metalization] metallization system [comprises] contains ground planes that are substantially wider than lines in said interconnecting [metalization] metallization structure.

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~~67~~. The method of claim ~~63~~ wherein said passivation layer [comprises] contains Plasma Enhanced CVD (PECVD) oxide.

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~~68~~. The method of claim ~~63~~ wherein said passivation layer [comprises] contains Plasma Enhanced CVD (PECVD) nitride.

70. The method of claim 63 wherein said insulating, separating layer [comprises] contains polyimide.

71. The method of claim 63 wherein said insulating, separating layer [comprises] contains the polymer benzocyclobutene (BCB).

72. The method of claim 63 wherein said insulating, separating layer is of a thickness after curing within [the] a range of approximately 1.0 to 30 um.

74. The method of claim 63 wherein said openings have an aspect ratio within [the] a range of approximately 1 to 10.

75. The method of claim 63 wherein said metal contacts is selected from the group [comprising] containing sputtered aluminum, CVD tungsten, CVD copper, electroplated copper, electroless nickel and damascene metal filling.

77. The method of claim 63 thereby furthermore functionally and physically extending said top [metalization] metallization system connected to said overlaying interconnecting [metalization] metallization structure, wherein said top [metalization] metallization system [comprises] contains a plurality of ground planes, in one or more layers, wherein furthermore said overlaying interconnecting [metalization] metallization structure directly interconnects a multiplicity of ground wires said ground wires to be connected with fine-wire ground wires thereby functionally extending or connecting said fine-wire ground wire metal interconnects with said wide-wire metal ground wire

interconnects contained within said top [metalization] metallization system thereby extending the fine-wire ground wires as contained within the overlaying interconnecting [metalization] metallization structure with said top [metalization] metallization system.

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~~78~~. The method of claim ~~63~~ thereby furthermore functionally and physically extending said top [metalization] metallization system connected to said overlaying interconnecting [metalization] metallization structure, wherein said top [metalization] metallization system [comprises] contains a plurality of signal planes, in one or more layers, wherein furthermore said overlaying interconnecting [metalization] metallization structure directly interconnects a multiplicity of signal wires said signal wires to be connected with fine-wire signal wires thereby functionally extending or connecting said fine-wire signal wire metal interconnects with said wide-wire metal signal wire interconnects contained within said top [metalization] metallization system thereby extending [the] fine-wire signal wires as contained within the overlaying interconnecting [metalization] metallization structure with said top [metalization] metallization system.

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~~79~~. The method of claim ~~63~~ thereby furthermore functionally and physically extending said top [metalization] metallization system

connected to said overlaying interconnecting [metalization] metallization structure, wherein said top [metalization] metallization system [comprises] contains a plurality of power planes, in one or more layers, wherein furthermore said overlaying interconnecting [metalization] metallization structure directly interconnects a multiplicity of power wires said power wires to be connected with fine-wire power wires thereby functionally extending or connecting said fine-wire power wire metal interconnects with said wide-wire metal power wire interconnects contained within said top [metalization] metallization system thereby extending [the] fine-wire power wires as contained within [the] an overlaying interconnecting [metalization] metallization structure with said top [metalization] metallization system.

PLEASE ADD THE FOLLOWING CLAIM.

~~30~~ 40. The method of claim 1 wherein said top metallization system contains one or more layers of metal whereby each layer of metal is separated from adjacent layers of metal by thick insulator layers of polyimide whereby layers of metal that form said top metallization system are interconnected thereby forming a system of metal interconnect lines whereby metal contacts and metal vias establish electrical contacts between layers within said top

metallization system whereby said layers of metal contain signal lines or ground lines or power lines of any combination thereof.

IN THE SPECIFICATION

1) page 4, line 13, after "invention", delete "is"

2) page 12, lines 11, replace "metalization" with "metallization"

3) page 12, lines 14, replace "metalization" with "metallization"

4) page 12, second paragraph, line 2 replace "have" with "has"

5) page 18, line 9, after "therefore", remove "with"

6) page 18, line 9, after "therefore" add "characterized by"

7) page 18, line 10, replace "effectively" with "effective"

8) page 19, line 10: replace "by" with "be"

9) page 22, second paragraph, line 2, after "can be", add "connected to"

10) page 22, second paragraph, line 8, replace "121" with "122"

11) page 22, second paragraph, line 10: replace "121" with "122"

12) page 22, second paragraph, line 11: replace "131" with "130"

13) page 22, after the second paragraph, please add:

The concept of pad relocation can be realized using the metal interconnection scheme described in this invention, to replace the function of BGA substrate 130. From Figs. 10 and 11 it is clear that the extended functionality and the extended

wiring ability that is provided by the interconnect wiring schemes that are created in the BGA substrate 130 are in fact created on the surface of and as an extension of the BGA device 100. This extension of the interconnect wiring results in the advantages that are provided by the method of the invention. Some of the methods and possibilities of interconnect line routing that can be implemented using the method of the invention are highlighted in the following paragraphs.

The metal conductors within the openings through the insulating layer and through the passivation layer that connect electrical contact pads of a top metallization structure with contact points of the interconnecting metallization structure are constructed and routed such that each of the electrical contact points of the interconnecting metallization structure is connected directly and sequentially with one electrical contact point of the top metallization structure. A fan-out effect is in this manner created for the electrical contact points of the interconnecting metallization structure, whereby the distance between electrical contact points of the top metallization structure is larger than the distance between electrical contact points of the interconnecting metallization structure by a measurable amount.

The number of electrical contact pads of the upper metallization structure can exceed the number of contact points of the interconnecting metallization structure by a considerable amount.

Metal conductors within the openings through the insulating layer and through the passivation layer connecting the electrical contact points of the top metallization structure with the contact points of the interconnecting metallization structure are constructed and routed such that each electrical contact point of the interconnecting metallization structure is connected directly but not necessarily sequentially with one electrical contact point of the top metallization structure thereby creating a pad relocation effect for the electrical contact points of the interconnecting metallization structure whereby the distance between electrical contact points of the top metallization structure is larger than the distance between the electrical contact point of the interconnecting metallization structure by a measurable amount and whereby furthermore the sequence or adjacency of electrical contact points of the interconnecting metallization structure is not necessarily the same as the sequence or adjacency between the electrical contact points of the top metallization structure.

The metal conductors within the openings through the insulating layer and through the passivation layer connecting electrical contact points on a top surface of the top metallization structure with contact points of the interconnecting metallization structure are constructed and routed such that functionally identical electrical contact points of the interconnecting metallization structure are interconnected and are connected with one electrical contact point or fewer electrical contact points of the top metallization structure thereby creating a reduction effect for the electrical contact points of the interconnecting metallization structure whereby the number of contact points for a particular electrical function within the electrical contact points of the top metallization structure is smaller than the number of electrical contact points of the interconnecting metallization structure by a measurable amount whereby furthermore the sequence or adjacency of the electrical contact points of the interconnecting metallization structure is not necessarily the same as the sequence or adjacency between the electrical contact points of the top metallization structure.